

Rec'd PCT/PTO 09 MAR 2005

## PATENT COOPERATION TREATY

## PCT

REC'D 28 DEC 2004

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

|                                                                                           |                                                          |                                              |
|-------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------|
| Applicant's or agent's file reference<br>PC-21005852                                      | FOR FURTHER ACTION See Form PCT/IPEA/416                 |                                              |
| International application No.<br>PCT/SE 2003/001455                                       | International filing date (day/month/year)<br>17.09.2003 | Priority date (day/month/year)<br>17.09.2002 |
| International Patent Classification (IPC) or national classification and IPC<br>H05H 1/42 |                                                          |                                              |
| Applicant<br>SMATRI AB et al                                                              |                                                          |                                              |

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 4 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
  - ☒ (sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:
    - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) \_\_\_\_\_, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
- This report contains indications relating to the following items:
 

|                                               |                                                                                                                                                                 |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Box No. I | Basis of the report                                                                                                                                             |
| <input type="checkbox"/> Box No. II           | Priority                                                                                                                                                        |
| <input type="checkbox"/> Box No. III          | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability                                                                |
| <input type="checkbox"/> Box No. IV           | Lack of unity of invention                                                                                                                                      |
| <input checked="" type="checkbox"/> Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> Box No. VI           | Certain documents cited                                                                                                                                         |
| <input type="checkbox"/> Box No. VII          | Certain defects in the international application                                                                                                                |
| <input type="checkbox"/> Box No. VIII         | Certain observations on the international application                                                                                                           |

|                                                                                                                                               |                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Date of submission of the demand<br><br>11.03.2004                                                                                            | Date of completion of this report<br><br>07.12.2004                           |
| Name and mailing address of the IPEA/SE<br>Patent- och registreringsverket<br>Box 5055<br>S-102 42 STOCKHOLM<br>Facsimile No. +46 8 667 72 88 | Authorized officer<br><br>Bo Gustavsson /OGU<br>Telephone No. +46 8 782 25 00 |

Form PCT/IPEA/409 (cover sheet) (January 2004)

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE 2003/001455

## Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

- ☐ This report is based on a translation from the original language into the following language \_\_\_\_\_, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1 - 16 as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the claims:
- pages \_\_\_\_\_ as originally filed/furnished
- pages\* 1 - 5 as amended (together with any statement) under Article 19
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the drawings:
- pages 1/5 - 5/5 as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE 2003/001455

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

|                               |        |             |     |
|-------------------------------|--------|-------------|-----|
| Novelty (N)                   | Claims | <u>1-32</u> | YES |
|                               | Claims |             | NO  |
| Inventive step (IS)           | Claims | <u>1-32</u> | YES |
|                               | Claims |             | NO  |
| Industrial applicability (IA) | Claims | <u>1-32</u> | YES |
|                               | Claims |             | NO  |

## 2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report:

D1: EP 1 113 711 A2

D2: WO 90 03 095 A1

D3: FR 2 191 394 A1

D4: Patent Abstract of Japan, abstract of JP 62 51869 A

The preliminary examination is based on the amended claims as filed under Article 19. Due to the amendments, the cited prior art described below now represent the general state of the art.

Document D1 describes a plasma burner comprising a number of annular electrode sections coaxially arranged to form a plasma channel. At the upper end of the plasma channel one or more cathodes are arranged to generate an arc discharge between the cathodes and the annular electrodes. Between some of the annular electrode sections inlets are provided for feeding e.g. powdered material into the plasma channel. The material inlets are arranged so that the material is fed tangentially into the channel.

D2 shows an electric arc generating device having a design similar to the arrangement as described in D1.

In D3, a device for reheating gases using electric arc discharges is described. The device comprises a plurality of coaxially arranged annular (cylindrical) electrodes forming a plasma channel and a cathode arranged at the upper end of the channel. Means for introducing material into the channel are also arranged along the channel.

.../...

## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V.

From D4 a discharge processing device for continuously heating and treating various materials is known. The device comprises coaxially arranged annular electrodes forming a plasma channel into which material to be treated is introduced.

The invention as claimed in the amended claims 1-32 differs from the cited prior art in that the diameter of the plasma channel in at least one section (annular electrode) is greater than the diameter in each section located upstream of said section, thereby reducing the risk of the powder material sticking to the inner walls of the channel.

The invention defined in claims 1-32 is not disclosed by any of these documents and therefore has novelty.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed plasma-spraying device and method of plasma-spraying. Therefore, the claimed invention is not obvious to a person skilled in the art. Accordingly, the invention is considered to involve an inventive step.

The invention is industrially applicable.

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PCT/SE2003/001455

## PATENT COOPERATION TREATY

22-06-2004

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PCT

NOTIFICATION CONCERNING  
AMENDMENTS OF THE CLAIMS(PCT Rule 62 and  
Administrative Instructions, Section 417)

From the INTERNATIONAL BUREAU

To:

Swedish Patent Office  
P.O. Box 5055  
S-102 42 Stockholm  
Sweden

Date of mailing (day/month/year)

25 May 2004 (25.05.2004)

In its capacity as International Preliminary Examining Authority

International application No.

PCT/SE2003/001455

International filing date (day/month/year)

17 September 2003 (17.09.2003)

Applicant

SMATRI AB et al

The International Bureau hereby transmits a copy of the amendments to the claims under Article 19 together with any accompanying statement (Rule 62).

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 338.70.90

Authorized officer

Laurence NICOLO

Telephone No. (41-22) 338 9949

## CLAIMS

1. A plasma-spraying device for spraying a powdered  
5 material, comprising electrodes (1), which form a plasma  
channel (2) having an inlet end (3) and an outlet end  
(4), and a means (5) for supplying said powdered material  
to said plasma channel (2), c h a r a c t e r i s e d in  
10 that said powder supply means (5) is arranged between a  
first section (6) of said electrodes (1) located upstream  
of the means (5) and a second section (5) of said  
electrodes (1) located downstream of the means (5), as  
seen in the direction of plasma flow of the plasma  
channel (2).

15 2. A plasma-spraying device as claimed in claim 1,  
wherein said first section (6) and said second section  
(7) are shaped in such manner that they bring about  
different conditions in the plasma channel (2) during use  
of the plasma-spraying device.

20 3. A plasma-spraying device as claimed in claim 1 or  
2, in which at least one of the following parameters is  
different between said first and second sections (6, 7):  
the length of the section, the number of electrodes (1)  
in the section (6, 7) and the geometry of the plasma  
25 channel (2) in the section (6, 7).

4. A plasma-spraying device as claimed in any one of  
the preceding claims, in which an additional powder  
supply means (9) is arranged between a third section (8)  
of electrodes (1) and one of said first and second  
30 sections (6, 7).

5. A plasma-spraying device as claimed in any one of  
the preceding claims, in which a plurality of powder  
supply means (5, 9) are provided, each of said powder  
supply means (5, 9) being arranged between a section of  
35 said electrodes located upstream of the means (6, 7) and  
a section of said electrodes located downstream (7, 8) of  
the means (5, 9).

6. A plasma-spraying device as claimed in any one of the preceding claims, in which the number of electrodes (1) in at least one section (6, 7, 8) is at least two.

7. A plasma-spraying device as claimed in claim 6,  
5 in which the number of electrodes (1) in the section (6) closest to said inlet end (3) of the plasma channel (2) is at least two.

8. A plasma-spraying device as claimed in any one of the preceding claims, in which the powder supply means  
10 (5, 9) forms a space (10) for supplying powder at an angle to a centre axis of the plasma channel (2).

9. A plasma-spraying device as claimed in claim 8, in which said space (10) is formed by a projection (11) on the electrode (1) closest upstream of the means (5, 9), which is arranged at a distance from a recess (12) in  
15 the electrode (1) closest downstream of the means (5, 9).

10. A plasma-spraying device as claimed in claim 9, in which said projection (11) is conical and makes an angle ( $\alpha$ ) with the centre axis of the plasma channel (2).

20 11. A plasma-spraying device as claimed in claim 10, in which said angle ( $\alpha$ ) is 15-25°.

12. A plasma-spraying device as claimed in any one of claims 9-11, in which said recess (12) is conical and makes an angle ( $\beta$ ) with the centre axis of the plasma  
25 channel (2).

13. A plasma-spraying device as claimed in claim 12, in which said angle ( $\beta$ ) is 17-30°.

14. A plasma-spraying device as claimed in claims 10 and 12, in which the difference between said angle of the  
30 recess (12) and said angle of the projection (11) ( $\beta - \alpha$ ) is 1.5° to 5°.

15. A plasma-spraying device as claimed in any one of the preceding claims, in which the powder supply means (5, 9) comprises openings (13) that are oriented at an  
35 angle to the centre axis of the plasma channel (2) to obtain a tangential powder supply.

16. A plasma-spraying device as claimed in any one of the preceding claims, in which the diameter of the plasma channel (2) in one section (7) is greater than the diameter of the plasma channel (2) in the section located upstream (6) of said section (7).

17. A plasma-spraying device as claimed in any one of the preceding claims, in which the diameter of the plasma channel (2) in at least one section (8) is greater than the diameter of the plasma channel (2) in each section (6, 7) located upstream of said section (8).

18. A plasma-spraying device as claimed in any one of the preceding claims, in which the length of the electrodes (1) is increased by their distance from the inlet end (3) of the plasma channel (2).

19. A plasma-spraying device as claimed in any one of the preceding claims, in which, at least in one section (6, 7, 8), the length of the furthest upstream electrode (1) equals the diameter of the plasma channel (8) in said furthest upstream electrode (1) in said section (6, 7, 8).

20. A plasma-spraying device as claimed in claim 19, in which, in one section (6, 7, 8), the length of the electrodes (1) in the section (6, 7, 8), which are located downstream of said furthest upstream electrode (1), is calculated as

$$L_n = n \times d_{\text{channel}}$$

where  $L_n$  is the length of electrode  $n$ ,  $n$  is the ordinal number of the electrode in a section and  $d_{\text{channel}}$  is the diameter of the plasma channel in said electrode  $n$ .

21. A plasma-spraying device as claimed in any one of claims 1-19, in which, at least in one section (6, 7, 8), the diameter of the plasma channel (2) varies in said section (6, 7, 8).

22. A plasma-spraying device as claimed in any one of the preceding claims, which further comprises a cathode (14) and an anode (15) arranged at a distance from the cathode (14) and coaxial therewith, between



which an electric arc is generated, during use of said device, into which gas is introduced to form a plasma, said electrodes (1) being arranged between said cathode (14) and said anode (15) forming said plasma channel (2).

5        23. A plasma-spraying device as claimed in any one of the preceding claims, in which said electrodes (1) are annular.

10        24. A plasma-spraying device as claimed in any one of the preceding claims, in which said electrodes (1) are coaxially arranged.

15        25. A method of plasma-spraying a powdered material by using a plasma-spraying device comprising electrodes (1), which form a plasma channel (2) having an inlet end (3) and an outlet end (4), characterised in that the powdered material is supplied to the plasma-spraying device in at least one supply point located between two sections (6, 7) of said electrodes (1), which sections (6, 7) are located respectively upstream and downstream of the supply point.

20        26. A method of plasma-spraying a powdered material as claimed in claim 25, in which the section (6) located upstream of the supply point is used to bring about the necessary conditions in the plasma flow.

25        27. A method of plasma-spraying a powdered material as claimed in claim 25 or 26, in which the section (7) located downstream of the supply point is used to control the heating of the powdered material and other properties of the powder.

30        28. A method of plasma-spraying a powdered material as claimed in any one of claims 25-27, in which at least one of the following parameters is different between said sections (6, 7) located respectively upstream and downstream: the length of the section (6, 7), the number of electrodes (1) in the section and the geometry of the plasma channel (2) in the section (6, 7).

35        29. A method as claimed in any one of claims 25-28, in which a powdered material is supplied in at least two

REPLACED BY  
PART 34 AMEND

supply points located between the two sections (6, 7; 7, 8) of said electrodes (1), which sections (6, 7; 7, 8) are located respectively upstream and downstream of the respective supply points.

5           30. Use of a device as claimed in any one of claims 1-24 for incinerating a powdered material.

          31. Use of a method as claimed in any one of claims 25-29 for incinerating a powdered material.

10           32. Use as claimed in claim 31 of a method as claimed in any one of claims 25-29 for incinerating a powdered material, in which additional powdered material is supplied for neutralising or transforming the powdered material intended to be incinerated.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 03/01455

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H05H 1/42

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B05B, C23C, H05H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                  | Relevant to claim No.      |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| X         | EP 1113711 A2 (GTV-GESELLSCHAFT FÜR THERMISCHEN VERSCHLEIS-SCHUTZ MBH), 4 July 2001 (04.07.01), column 11, line 9 - column 13, line 4, figure 1                                     | 1,3-5,15,16,18,21-25,27-29 |
| A         | --                                                                                                                                                                                  | 30,31                      |
| X         | WO 9003095 A1 (COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION), 22 March 1990 (22.03.90), page 5, line 15 - line 26; page 6, line 12 - page 8, line 17, figures 1,3,4 | 1,4,5,8,15,22-25,27,29     |
| A         | --                                                                                                                                                                                  | 6,7,9,10,30,31             |

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 October 2003

Date of mailing of the international search report

07 -11- 2003

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 03/01455

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                     | Relevant to claim No.    |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| A         | FR 2191394 A1 (SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE), 1 February 1974 (01.02.74),<br>the whole document<br><br>--                                                                               | 1-6, 20,<br>22-25, 28-31 |
| A         | PATENT ABSTRACTS OF JAPAN<br>Vol. 018, No. 641 (E-1639),<br>06 December 1994 (1994-12-06)<br>abstract<br>& JP 62 51869 A (SANJO ELECTRIC CO LTD),<br>09 September 1994 (1994-09-09)<br><br>--<br>----- | 30, 31                   |

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE 03/01455

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 2, 26  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
**see extra sheet**
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE 03/01455

Claims 2 and 26 are not drafted in a manner that meets the requirements in Article 6, PCT. It is not believed that the expressions "...åstadkommer skilda villkor..." (English translation: "...brings about various conditions...") (claim 2) or "...skapa erforderliga förhållanden..." (English translation: "...create necessary conditions...") (claim 26) clearly specifies all of the essential features needed to define an invention.

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

06/09/03

International application No.  
**PCT/SE 03/01455**

| Patent document<br>cited in search report |         |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------|----|---------------------|----------------------------|---------------------|
| EP                                        | 1113711 | A2 | 04/07/01            | DE 19963904 A,C            | 16/08/01            |
| WO                                        | 9003095 | A1 | 22/03/90            | AT 140118 T                | 15/07/96            |
|                                           |         |    |                     | AU 620455 B                | 20/02/92            |
|                                           |         |    |                     | AU 4312289 A               | 02/04/90            |
|                                           |         |    |                     | CA 1330831 A,C             | 19/07/94            |
|                                           |         |    |                     | DE 68926787 D,T            | 16/01/97            |
|                                           |         |    |                     | EP 0436576 A,B             | 17/07/91            |
|                                           |         |    |                     | SE 0436576 T3              |                     |
|                                           |         |    |                     | JP 2813398 B               | 22/10/98            |
|                                           |         |    |                     | JP 4500741 T               | 06/02/92            |
|                                           |         |    |                     | US 5227603 A               | 13/07/93            |
| FR                                        | 2191394 | A1 | 01/02/74            | NONE                       |                     |